Tubeskin thermocouple assembly
Model TC59-W

Applications

- Chemical industry
- Power generation
- Refineries
- Heating furnaces
- Heat exchangers

Special features

- Application ranges from 0 ... 1,260 °C (32 ... 2,300 °F)
- Flexible sheathed cable, mineral-insulated internal leads
- High mechanical strength, shock-resistant
- Explosion-protected versions

Description

The WELD-PAD enables the measurement of temperatures on plain or contoured surfaces.

The WELD-PAD sensor hot end is a contoured weld pad attached to a mineral-insulated cable (sheathed cable). It consists of a metal outer sheath, which contains the insulated internal leads, compressed within a high-density ceramic composition. The internal leads are made from thermo material. The material of the outer sheath can be selected to match the application. At one end of the sheathed cable, the internal leads are welded together to form an insulated (ungrounded) or non-insulated (grounded) measuring point.

At one end of the sheathed cable, the ends of the leads are connected and the sheathed cable is hermetically sealed using a sealing compound. The lead ends form the platform for the electrical connection. Cables, plug-in connectors or connector sockets can be connected to them.

Sensor design

The WELD-PAD is designed as a contoured weld pad designed to suit each tube and sensor size.

The WELD-PAD design is used in low variability applications where accuracy is not critical. It provides measurement readings for trending, excursions and tracking.

When critical accuracy is required refer to data sheets TE 65.56, TE 65.57 and TE 65.59

Data sheets showing similar products:
- Tubeskin thermocouple assembly; model TC59-R; see data sheet TE 65.56
- Tubeskin thermocouple assembly; model TC59-X; see data sheet TE 65.57
- Tubeskin thermocouple assembly; model TC59-V; see data sheet TE 65.59
Sensor

Sensor types

<table>
<thead>
<tr>
<th>Type</th>
<th>Recommended max. operating temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IEC 60584-1</td>
</tr>
<tr>
<td>K</td>
<td>1,200 °C (2,192 °F)</td>
</tr>
<tr>
<td>J</td>
<td>750 °C (1,382 °F)</td>
</tr>
<tr>
<td>N</td>
<td>1,200 °C (2,192 °F)</td>
</tr>
<tr>
<td>E</td>
<td>900 °C (1,652 °F)</td>
</tr>
</tbody>
</table>

WELD-PAD material

<table>
<thead>
<tr>
<th>WELD-PAD material</th>
<th>Resistance in sulphurous ambient</th>
<th>maximum temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4665 (Hastelloy X®)</td>
<td>Medium</td>
<td>1,150 °C (2,102 °F)</td>
</tr>
<tr>
<td>2.4816 (Inconel 600®)</td>
<td>Low</td>
<td>1,150 °C (2,102 °F)</td>
</tr>
<tr>
<td>Stainless steel 1.4841 (310)</td>
<td>Medium</td>
<td>1,150 °C (2,102 °F)</td>
</tr>
<tr>
<td>Stainless steel 1.4749 (446)</td>
<td>High</td>
<td>1,150 °C (2,102 °F)</td>
</tr>
<tr>
<td>Haynes HR 160®</td>
<td>Very high</td>
<td>1,200 °C (2,192 °F)</td>
</tr>
<tr>
<td>Pyrosil D®</td>
<td>High</td>
<td>1,250 °C (2,282 °F)</td>
</tr>
<tr>
<td>Stainless steel 1.4401 (316)</td>
<td>Medium</td>
<td>850 °C (1,562 °F)</td>
</tr>
</tbody>
</table>

Other materials on request

1) Depending on design

Mechanical design

Sensor

Through its pad design the WELD-PAD provides a strong welded connection on three sides.

Sheathed cable

The sheathed cable is flexible. The minimum bending radius is five times the sheath diameter.

Sheath diameter

- 6.0 mm
- 6.4 mm (¼“)
- 7.9 mm (5/16“)
- 9.5 mm (⅜“)

Other sheath diameters on request

WELD-PAD and sheath materials

- Ni-alloy 2.4816 (Inconel 600)
  - up to 1,200 °C / 2,192 °F (air)
  - standard material for applications which require specific corrosion resistance properties under exposure to high temperatures, resistant to induced stress corrosion cracking and pitting in media containing chloride
  - highly resistant to halogens, chlorine, hydrogen chloride
  - problematic applications in sulphurous fuels

- Steels
  - up to 850 °C / 1,562 °F (air)
  - good corrosion resistance with aggressive media as well as steam and flue gases in chemical media

Tolerance value

For the tolerance value of thermocouples, a cold junction temperature of 0 °C has been taken as the basis.

When using a compensating cable or thermocouple cable, an additional measuring error must be considered.

Sensor junction

The WELD-PAD is supplied as an insulated (ungrounded) or non-insulated (grounded) measuring point.

For detailed specifications for thermocouples, see Technical information IN 00.23 at www.wika.com.
Design and electrical connection

WELD-PAD thermocouples are classified into the following variants, depending on the nature of their electrical connections:

Fixed connection (compression fitting) to the furnace

- Cable length 150 mm, other lengths on request
- Compensating cable type depending on the sensor type, PTFE-insulated
- The sealing from the process is performed by the compression fitting. It can be supplied in most common thread sizes.
- A connection head can be mounted directly to the neck or remotely.

Sliding connection (piston/spring) to the furnace

Spring-loaded style

- Cable length to user specifications
- Number of leads depends on the number of sensors, lead ends bare
- Insulation (material / ambient temperature max.):
  - PVC 105 °C (221 °F)
  - PTFE 250 °C (482 °F)
  - Fibreglass 400 °C (752 °F)
- A connection head can be mounted remotely.

Piston style
Field temperature transmitter (option)

**Field temperature transmitter, model TIF50**

As an alternative to the standard connection head, the sensor can be fitted with an optional model TIF50 field temperature transmitter.

A remote version for tube/surface mounting for the sensor designs with connection cable is also possible. The field temperature transmitter comprises a 4 ... 20 mA/HART® protocol output and is equipped with an LCD indication module.

**Connection head with digital indicator (option)**

**Connection head with digital indicator, model DIH10**

As an alternative to the standard connection head, the thermometer can be fitted with an optional DIH10 digital indicator.

For operation, a 4 ... 20 mA transmitter is needed, which is mounted to the measuring insert. The indication range is factory configured to the measuring range of the transmitter.

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<table>
<thead>
<tr>
<th>Model</th>
<th>Material</th>
<th>Cable entry</th>
<th>Ingress protection</th>
<th>Cap</th>
<th>Surface finish 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSZ</td>
<td>Aluminium</td>
<td>M20 x 1.5</td>
<td>IP65</td>
<td>Hinged cover with cylinder head screw</td>
<td>Blue, painted</td>
</tr>
<tr>
<td>BSZ-K</td>
<td>Plastic</td>
<td>M20 x 1.5</td>
<td>IP65</td>
<td>Hinged cover with cylinder head screw</td>
<td>Plastic</td>
</tr>
<tr>
<td>BSZ-H</td>
<td>Aluminium</td>
<td>M20 x 1.5</td>
<td>IP65</td>
<td>Hinged cover with cylinder head screw</td>
<td>Blue, painted</td>
</tr>
<tr>
<td>BSS</td>
<td>Aluminium</td>
<td>M20 x 1.5</td>
<td>IP65</td>
<td>Hinged cover with clip</td>
<td>Blue, painted</td>
</tr>
<tr>
<td>1/4000 F</td>
<td>Aluminium</td>
<td>½ NPT</td>
<td>IP66 3)</td>
<td>Screw cover</td>
<td>Blue, painted</td>
</tr>
<tr>
<td>1/4000 S</td>
<td>Stainless steel</td>
<td>½ NPT</td>
<td>IP66 3)</td>
<td>Screw cover</td>
<td>Blank</td>
</tr>
<tr>
<td>5/6000 F</td>
<td>Aluminium</td>
<td>3 x M20 x 1.5</td>
<td>IP66 3)</td>
<td>Screw cover</td>
<td>Blue, painted</td>
</tr>
<tr>
<td>7/8000 W</td>
<td>Aluminium</td>
<td>½ NPT</td>
<td>IP66 3)</td>
<td>Screw cover</td>
<td>Blue, painted</td>
</tr>
<tr>
<td>7/8000 S</td>
<td>Stainless steel</td>
<td>½ NPT</td>
<td>IP66 3)</td>
<td>Screw cover</td>
<td>Blank</td>
</tr>
<tr>
<td>DIH10/ BSZ-H</td>
<td>Aluminium</td>
<td>M20 x 1.5</td>
<td>IP65</td>
<td>Hinged cover with cylinder head screw and LED indicator DIH10</td>
<td>Blue, painted with indicator</td>
</tr>
</tbody>
</table>

1) Standard, others on request  
2) RAL 5022  
3) Suitable seal/cable gland required

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**Field temperature transmitter, model TIF50**

**Connection head with digital indicator, model DIH10**
Transmitter (option)

A transmitter can be mounted directly into the connection head.

The following installation variants are thus possible:
- ○ Mounted instead of terminal block
- ● Mounted within the cap of the connection head
- – Mounting not possible

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Explosion protection</th>
<th>Data sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>T32</td>
<td>Digital transmitter, HART® protocol</td>
<td>Optional</td>
<td>TE 32.04</td>
</tr>
<tr>
<td>T53</td>
<td>Digital transmitter FOUNDATION™ Fieldbus and PROFIBUS® PA</td>
<td>Standard</td>
<td>TE 53.01</td>
</tr>
<tr>
<td>TIF50</td>
<td>Digital field temperature transmitter, HART® protocol</td>
<td>Optional</td>
<td>TE 62.01</td>
</tr>
</tbody>
</table>

Design and installation

WIKA uses trained specialists to customise the temperature measuring points to the application. These specialists utilise best practices derived from scientific properties to optimise the life and accuracy of the thermocouple. They make suggestions to optimise the system for temperature, movement, and burner firing.

Some design considerations that can help determine measuring points for the specific application in order to choose the best suitable product:

- Material compatibility with furnace tube
- Heat transfer (radiation, convection, conduction)
- Junction (grounded, ungrounded)
- Thickness of the mineral-insulated cable (flexibility vs. durability)
- Expansion loops (location and design)
- Flame impingement
- Furnace exit design options
- Burner fuel (flue gas composition)
- Welding procedure (TIG, stick, temperature monitoring)
- Mounting (location, orientation)
- Operating vs. design temperatures
- Bending radius
- Path to furnace wall
- Tube clips (location and routing)
- Connection head (material, location, approvals)
- Furnace design (burner locations)

Expansion loops

Expansion loops should be designed to account for maximum tube movement from startup position to operating temperature. Loops should be designed in accordance with allowable space available.

Examples of expansion loops:

S-loop

Single coil

Multiple coil

Spiral loop
Electrical connection

Ceramic terminal block

![Ceramic terminal block diagram]

Dual thermocouple

Crastin terminal block

![Crastin terminal block diagram]

Single thermocouple

Dual thermocouple

Cable connection

Cable

Colour coding of the wire ends see table

Single thermocouple

Dual thermocouple

Colour code of cable

IEC 60584-3

<table>
<thead>
<tr>
<th>Thermocouple type</th>
<th>Positive leg</th>
<th>Negative leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>J</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>E</td>
<td>Violet</td>
<td>White</td>
</tr>
<tr>
<td>N</td>
<td>Pink</td>
<td>White</td>
</tr>
</tbody>
</table>

ASTM E230

<table>
<thead>
<tr>
<th>Thermocouple type</th>
<th>Positive leg</th>
<th>Negative leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>K</td>
<td>Yellow</td>
<td>Red</td>
</tr>
<tr>
<td>J</td>
<td>White</td>
<td>Red</td>
</tr>
<tr>
<td>E</td>
<td>Violet</td>
<td>Red</td>
</tr>
<tr>
<td>N</td>
<td>Orange</td>
<td>Red</td>
</tr>
</tbody>
</table>

Explosion protection (option)

Thermocouples of the TC59 series are available with an EC-type examination certificate for “intrinsically safe”, Ex i, ignition protection. These instruments comply with the requirements of the ATEX directive for gas and dust.

The classification/suitability of the instrument (permissible power, $P_{\text{max}}$, as well as the permissible ambient temperature) for the respective category can be seen on the EC-type examination certificate and in the operating instructions.

Built-in transmitters have their own EC-type examination certificate. The permissible ambient temperature ranges of the built-in transmitters can be taken from the corresponding transmitter approval.

The internal inductance ($L_i$) and capacitance ($C_i$) for cable probes are found on the product label and should be taken into account when connecting to an intrinsically safe power supply.

Thermocouples of the TC59 series are also available with a CSA or FM certificate, Class I Division 1 or Class I Division 2 depending on the style.

For assemblies supplied with a WIKA termination head and flame path, Class I Division 1 may be applicable.

For assemblies supplied with a WIKA termination head and flexible armour, Class I Division 2 may be applicable.

Consult WIKA for your explosion protection requirements.
Approvals

<table>
<thead>
<tr>
<th>Logo</th>
<th>Description</th>
<th>Country</th>
</tr>
</thead>
</table>
| CE   | EU declaration of conformity  
- EMC directive 1)  
EN 61326 emission (group 1, class B) and interference immunity (industrial application)  
- ATEX directive (option)  
Hazardous areas  
II 2 G Ex ia IIC | European Union |
| IECEx (option) | Hazardous areas | International |
| FM (option) | Hazardous areas | USA |
| CSA (option) | Safety (e.g. electr. safety, overpressure, ...), Hazardous areas | Canada |
| EAC (option) | EMC directive, Hazardous areas | Eurasian Economic Community |
| INMETRO (option) | Metrology, measurement technology, Hazardous areas | Brazil |
| NEPSI (option) | Hazardous areas | China |
| KCs - KOSHA (option) | Hazardous areas | South Korea |
| - | PESO (option) | Hazardous areas | India |

1) Only for built-in transmitter

Certificates (option)

- 2.2 test report
- 3.1 inspection certificate
- DKD/DAkkS calibration certificate

Accessories

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
</table>
| Tube clips  
Material: Stainless steel 310 or Inconel 600®  
- MI cable Ø 6.0 ... 6.4 mm (¼")  
- MI cable Ø 7.9 mm (5/16")  
- MI cable Ø 9.5 mm (⅜") |

Ordering information

Model / Explosion protection / Connection head / Cable entry / Terminal block, transmitter / Design of thread / Measuring element / Sensor type / Temperature range / Probe diameter / Pipe diameter / Materials / Thread size / Connection cable, sheath / Lenghts N, W, A / Options

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